Syllabus.

EIBEL PROCESS COMPANY *v.* MINNESOTA & ONTARIO PAPER COMPANY.

CERTIORARI TO THE CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT.

No. 178. Argued January 5, 8, 1923.—Decided February 19, 1923.

1. The Eibel patent, No. 845,224, for an improvement on Fourdrinier paper-making machines, whereby, mainly through a substantial elevation of the breast-roll end of the moving screen or "paper-making wire", the liquid stock discharged upon the screen acquires through gravity an additional speed, enabling it to keep pace with the screen at the critical paper-forming point, thus avoiding injurious disturbances of the stock when the screen moves very rapidly, and making possible a much speedier production of good paper than was theretofore obtained from the machines without the improvement,—*held*, a new and useful invention. P. 52.
2. The prompt and general adoption of the improvement, with increased productivity of the machines to which it was applied, is strong evidence of its novelty and usefulness. P. 56.
3. Previous adoption of a comparatively slight pitch of the screen, but for another and distinct purpose, did not constitute anticipation of this invention. P. 58.
4. Oral evidence of prior discovery must be clear and satisfactory to sustain an attack on a patent. P. 60.
5. A patent for a very meritorious improvement on an old machine, substantially advancing the art, is entitled to a liberal construction. P. 63.
6. In this case, the patent is construed to cover a Fourdrinier machine in which the pitch of the wire screen is used, not as the sole, but as an appreciable factor, in addition to those already present, in bringing about approximate equal velocity of stock and screen at the point where, otherwise, injurious disturbances of the stock would be produced. P. 65.
7. General descriptive terms in a patent are not objectionable where it would have been difficult to make them more specific and where the description is sufficient to enable those skilled in the art to apply the invention. P. 65.
8. Accidental results, not appreciated, will not constitute anticipation. P. 66.

9. An increased elevation in the pitch of an element in a machine beyond that previously employed for another purpose is not mere matter of degree but amounts to invention when applied successfully to remedy an old defect in connection with the discovery of its cause. P. 66.

10. The novelty of an invention is not impeached by the fact that the same results may be achieved in a different way. P. 69.

11. The patent in this case, claims 1, 2, 3, 7, 8 and 12, were infringed by defendants. P. 69.

12. The first five of these are claims for a machine, and not a process. P. 70.

274 Fed. 540, reversed.

This was a bill in equity charging the infringement of a patent and seeking an injunction, an accounting and damages. The patent No. 845,224 issued to William Eibel, February 26, 1907. The application was filed August 22, 1906. The specifications describe the patent as for an improvement for Fourdrinier machines for paper making and say that it "has for its object to construct and arrange the machine whereby it may be run at a very much higher speed than heretofore and produce a more uniform sheet of paper which is strong, even, and well formed." The contention of the plaintiff, the petitioner here, is that the improvement was an important step in the art of paper making, and increased the daily product from twenty to thirty per cent.

The patent was held void by the District Court for the Western District of New York in the case of *Eibel Process Co.* v. *Remington-Martin Co.*, 226 Fed. 766 (1914). On appeal, the Circuit Court of Appeals for the Second Circuit reversed the decree of dismissal in the District Court, sustained the patent and found infringement of Claims Nos. 1, 2 and 3, but did not pass upon Claims Nos. 7, 8 and 12. 234 Fed. 624 (1910). The bill in the present case was filed in the District Court for Maine, January 1, 1917. That court in 1920 held the patent valid and entered a decree of injunction and for damages. 267

Fed. 847. On appeal, the Circuit Court of Appeals for the First Circuit reversed the decree and directed the dismissal of the bill. 274 Fed. 540 (1921). Because of the conflict in the two circuits, certiorari was granted to review the latter decree.

The Fourdrinier machine has for many years been well known and most widely used for making news print paper. Its main feature is an endless wire cloth sieve passed over a series of rolls at a constant speed. The sieve known as the "wire" is woven with 60 or 70 meshes to the inch. It may be 70 feet or more in length and is often more than 100 inches in width. Its working surface with the total length of 70 feet is about 30 feet, the rest being taken up in the return of the wire underneath. At what is called the breast roll, at one end of the machine, there is discharged upon the wire from a flow box or pond, a constant stream of paper making stock of fibres of wood pulp mixed with from 135 to 200 times their weight of water of the consistency and fluidity of diluted milk. As this stream moves along the wire, the water drains through its meshes and the fibres are deposited thereon. The process is stimulated by a device to shake the wire with constant and rapid sidewise thrusts, forward and back, which insures the proper interlocking and felting of the stock as it progresses, the water continuing to drain from it. At the end of the surface length of the wire, the stock reaches what are called the couch rolls between which it is pressed and then in the form of a sheet of uniformly distributed pulp, felted sufficiently to hold together, it leaves the wire and is carried through a series of rolls or calendars by which the sheet is pressed and dried and from which it emerges to be rolled up as finished paper.

In the flow box or "pond" where the stream of pulp stock is stored there is a gate or door forming the end of the flow box called the "slice" by lifting which the stock

is given the opportunity to flow upon the wire. The stream thus issuing is given a width of the desired sheet of paper and a depth regulated by the height to which the slice is lifted. The stream on the wire is prevented from flowing off the sides by "deckle straps" which are thick rubber bands, resting on each side of the wire at each side of the pulp. Travelling with the wire, they form lateral walls confining the stock till it is too dry to flow. Between the breast roll where the stream of liquid stock strikes the wire, and the couch rolls at the end of the surface length of the wire, there is a series of parallel horizontal rolls supporting the wire, called table rolls, and, twenty feet from the breast roll, there are placed under the wire and in contact with it, three suction boxes in succession, in which a partial vacuum is maintained, and through them is sucked out the greater part of the water remaining in the wet sheet of the pulp. Placed above the wire and just beyond the first suction box is what is called the "Dandy Roll," which is faced with wire cloth. Its office is to impress the upper surface of the forming sheet of paper and give it a texture similar to that which the lower surface of the paper has from its contact with the wire. It may also carry the design which is to give the watermark to the sheet if such a mark is desired. Beyond this is a larger roll called the guide roll, arranged with an automatic device varying its axis so as to keep the wire straight. From the guide roll the wire drops below the plane to the couch rolls already referred to.

These machines are very large, some of them weighing more than a million pounds, and their cost will range as high as one hundred twenty-five thousand dollars. They are run night and day in order that the capital invested in them may yield a proper return. Speed which increases production is therefore of the highest importance. Eibel's patent had for its avowed purpose the increase of this speed.

Eibel says in his specifications:

"My invention is embodied, essentially, in the first part or element of the machine having the Fourdrinier wire or paper-making wire, and consists in causing the stock to travel by gravity in the direction of movement of the making-wire and approximately as fast as the making-wire moves, thereby resulting in a "gravity-feed" for the machine. The stock may be and preferably is caused to travel more rapidly than the normal or usual speed of the making-wire for a certain grade of stock, and means are provided for increasing the speed of the machine so as to cause the making-wire to move at a higher rate of speed than usual, being substantially equal to the speed of the rapidly-moving stock. To accomplish this result in a simple manner the breast-roll end of the paper-making wire is maintained at a substantial elevation above the level, thereby providing a continuous downwardly-moving paper-making wire, and the declination thus given to the wire is such that the stock is caused to travel by gravity in the direction of the movement of the wire and substantially as fast as the wire moves. The declination of the paper-making wire may be adjustable or the speed of the wire may be variable, or both the declination and speed of the wire may be adjustable, in order that the velocity produced by gravity in the stock on the declining wire will approximately equal the speed of the wire. By this arrangement the speed of the machine may be increased to such an extent as to bring the speed of the making-wire up to the maximum velocity of the rapidly-moving stock and a strong, even and well-formed sheet produced which is more uniform than usual."

Two figures accompany the specifications of the Eibel patent. Figure No. 1 shows the wire of the Fourdrinier machine in outline from the breast roll to the guide and couch rolls, with a screw device for raising and lowering

the breast roll and wire from the horizontal. The outline shows an elevation of the breast roll and wire so that the angle between the wire and the horizontal at the guide roll is about four per cent., which in a surface length of 30 feet would mean an elevation of 12 inches at the breast roll. The other figure No. 2 shows a device for regulating the speed of the wire applied at the lower couch roll.

Again the patentee says:

"For the purpose of increasing the speed of the machine to the maximum I maintain the breast-roll end of the making-wire at a high elevation above the level, so that the stock travels by gravity much faster than the making-wire ordinarily runs for a certain grade of stock, and I then increase the speed of the machine to such extent as to bring the rate of speed of the making-wire up to the speed of the rapidly-moving stock, and as a result the capacity of the machine is largely increased.

"I find in practice that by providing a gravity-feed operating substantially as herein described the stock runs smoothly and evenly without waving or rippling, and the fibers are thereby permitted to settle with great uniformity as regards their distribution over the the wire, so that the paper in addition to being well formed is very uniform. Furthermore, as the stock is moving with the paper-making wire instead of being moved by the wire, or essentially by the wire, the formation of the paper will begin at the start and will continue to the end of the travel of the stock with the wire."

The claims in question are:

1. A Fourdrinier machine having the breast-roll end of the paper-making wire maintained at a substantial elevation above the level, whereby the stock is caused to travel by gravity, rapidly, in the direction of movement of the wire, and at a speed approximately equal to the speed of the wire, substantially as described.

2. A Fourdrinier machine having the breast-roll end of the paper-making wire maintained at a high elevation,

whereby the stock is caused to travel by gravity faster than the normal speed of the wire for a certain grade of stock, and having means for increasing the speed of the machine to cause the wire to travel at substantially the same rate of speed as the rapidly-moving stock, substantially as described.

3. A Fourdrinier machine having the paper-making wire declined from the breast-roll to the guide-roll, the breast-roll end of the wire being maintained at a substantial elevation above the level, whereby the stock is caused to travel by gravity, rapidly, in the direction of movement of the wire and at a speed approximately equal to the speed of the wire, substantially as described.

7. A Fourdrinier machine having the paper-making wire declined from the breast-roll to the guide-roll, and the suction-boxes supported at a corresponding declination, substantially as described.

8. A Fourdrinier machine having the paper-making wire declined from the breast-roll to the guide-roll, and the several suction-boxes arranged at different elevations, substantially as described.

12. In a Fourdrinier machine, a downwardly-moving paper-making wire, the declination and speed of which are so regulated that the velocity of the stock down the declining wire, caused by gravity, is so related to the velocity of the wire in the same direction, that waves and ripples on the stock are substantially avoided and the fibers deposited with substantial uniformity on the wire, substantially as described.

Mr. Frederick P. Fish, with whom *Mr. Guy Cunningham* and *Mr. Harrison F. Lyman* were on the briefs, for petitioner.

Mr. Amasa C. Paul, with whom *Mr. Livingston Gifford, Mr. Richard Paul, Mr. Maurice M. Moore* and *Mr. Nathan Heard* were on the briefs, for respondent.

MR. CHIEF JUSTICE TAFT, after stating the case as above, delivered the opinion of the Court.

The evidence in the case establishes that before Eibel entered the field, continued high speeds in the wire of the Fourdrinier machine much beyond five hundred feet a minute resulted in defective paper. Eibel concluded that this was due to the disturbance and ripples in the stock as it was forming at a point between the breast roll and the first suction box, caused by the fact that at that point the wire was travelling much faster than the stock, and that if at that point the speed of the flowing stock could be increased approximately to the speed of the wire, the disturbance and rippling in the stock would cease and the defects would disappear from the paper product. Accordingly he proposed to add to the former speed of the stock by substantially tilting up the wire and giving the stock the added force of the down hill flow. He thought that as long as he could thus maintain equality of speed between stock and wire at the crucial point, and prevent the disturbance and rippling there, a further increase in the speed of the wire would not result in a defective product. He confirmed this by actual trial.

The first and most important question is whether this was a real discovery of merit. The Circuit Court of Appeals thought not. The prior art and the obvious application of the principle that water will run down hill in their opinion robbed it of novelty or discovery. The issue is one largely of evidence.

The plaintiff below introduced the patent and some evidence of infringement and a single expert to explain the discovery and invention and rested. Then the defendant brought in a mass of evidence to show prior discovery and use, to impeach the utility of plaintiff's alleged invention and to demonstrate the indefiniteness of specification and claims. The fact that the adjudication of the

validity of the patent would impose a royalty on many of the paper manufacturers of the country who were not already licensees of the plaintiff led to the defendant's sending a circular letter to awaken the interest and secure the help of all so situated. This, as the record shows, had the effect to invoke offers of testimony on the critical points in the case from the unlicensed part of the trade. The plaintiff adduced a few witnesses in rebuttal as to particular details and the same expert as in chief. The plaintiff's case as presented on the record is largely the presumption of validity and novelty attaching to the patent and such evidence as comes from defendant's witnesses. A case that can be made out in all its elements by cross-examination of opposing witnesses is a strong case. Implication of facts and conditions falling from the mouths of witnesses when only collateral to the exact point of inquiry for which they are called is generally the most trustworthy evidence because the result of the natural, so to say, subconscious adherence to truth uninfluenced by a knowledge or perception of the bearing of the implication on the ultimate issue in the case.

A thorough examination of the whole voluminous record produces a satisfying conviction, first, that for years news print paper makers and manufacturers of paper-making machinery were engaged in seeking a method of increasing the speed of the news print machines, and that they had succeeded by improving the stock and by strengthening the parts in bringing the speed of the wire and the delivered paper up to between five and six hundred feet a minute, but that, when these high speeds were attained and maintained for any length of time, though they served to enable manufacturers to advertise such maximums, their continued and regular operation showed defects in the paper which were only overcome by a reduction of speed to something less than five hundred feet. As against advertisement, and the exuberant

memory of witnesses, the actual contemporaneous record of daily figures of production whenever brought to light justifies this conclusion. A leading manufacturer, one of the most enthusiastic witnesses on the subject of speed before Eibel, produced a memorandum of a visit he made in October, 1904, less than two years before Eibel's application, to see the operation of a machine he had manufactured which he called "the banner installation of the world" and made an entry in his diary, "Grand Sight—475 feet." There is the usual unconscious straining of memory without written record carried back ten or fifteen years, but the evidence on the whole is satisfying that the practical speed for the regular production of good news print paper never much exceeded that speed which had gratified the pride of this witness. A typical case is in that of machines made by Bagley & Sewall, large manufacturers of paper-making machines for the Laurentide Paper Company. The president of Bagley & Sewall testified that the speed of the machine was 552 feet a minute with satisfactory paper, and that he visited Laurentide in October, 1904, and counted the revolutions himself. He produced a letter from Mr. Chahoon, of the Laurentide Company, of about the same date, confirming his statement of the count and the satisfactory product, and an advertisement of Bagley & Sewall to the same effect of January, 1905. In rebuttal, a monthly record of the work of the machine is produced by the foreman at Laurentide for this same machine from January, 1905, to December, 1906, showing the speed to vary from a maximum of 518 in 1905 to 475 in 1908, with a general average of less than 500, and an explanation that the high speeds did not make a good product and were reduced. Our conclusion is confirmed, and indeed the importance of the issue of fact as to maximum speed before Eibel is minimized, by the circumstance, uncontroverted, that the owners of these fastest machines, at once upon Eibel's publi-

cation of his discovery, adopted his pitch and increased their product.

What Eibel tried to do was to enable the paper maker to go to six or seven hundred feet and above in speed and retain a good product. Did he do it? Eibel was the superintendent of a paper mill at Rhinelander, Wisconsin. Before August, 1906, he raised the pitch of the wire from two or three inches to twelve inches and greatly increased the speed with a satisfactory product, and in that month he applied for a patent. The defendant's witnesses without exception refer to that disclosure as something that surprised and startled the paper-making trade. It spread, to use the expression of one witness, like wild fire. There were those who hesitated to take the venturesome step to give such an unheard-of pitch to the wire and waited until others assumed the risk, but the evidence is overwhelming that within a short interval of a year or two all of the fast machines were run with wires at a pitch of twelve inches and that this pitch has been increased to fifteen and eighteen and even twenty-four inches, that the speed of the machines with satisfactory product has increased to six hundred, six hundred and fifty, and even seven hundred feet, with plans now even for a thousand feet and that the makers of two-thirds of the print paper of the country are licensees of Eibel.

Defendant attempts to break the effect of this evidence by showing that five of the largest paper manufacturers who are licensees of Eibel are also shareholders in the Eibel Process Company, the plaintiff, and that they make 2200 tons of the 5000 tons of paper made daily in the United States. This circumstance seems to have had influence with the Circuit Court of Appeals. There are, however, ten other paper-making companies, not shareholders, who are licensees and use the Eibel pitch, and whose aggregate production is 1200 tons a day; and what is equally significant, thirteen other companies have con-

tributed to a fund to help in resisting the establishment of the right of Eibel to claim a royalty for the use of this high or substantial pitch of the wire in the making of paper. Presumably they too find it wise to use the Eibel pitch. The paper makers in this country who do not use the Eibel pitch, therefore, are few. It can hardly be that dividends on the shares of stock in the Eibel Company held by the five large companies would furnish motive enough for them to continue to be licensees and to use something that was not of great advantage to them in their chief business of making paper; and certainly no such motive would explain the action of the licensees who are not stockholders or that of the infringers, in continuing to use the Eibel pitch. It should be said that one of the large manufacturers of paper-making machinery called by the defendant said that since 1907 he had not installed a single machine without the Eibel pitch.

The fact that the Eibel pitch has thus been generally adopted in the paper-making business and that the daily product in paper making has thus been increased at least twenty per cent. over that which had been achieved before Eibel is very weighty evidence to sustain the presumption from his patent that what he discovered and invented was new and useful. Of course, although very persuasive, it is not conclusive and may be explained. This brings us to the consideration of the evidence of the prior art and the contention of the defendant, and the conclusion of the court below, that the step taken by Eibel, so far as he took one, was a mere obvious application of fully developed devices in the prior art.

Eibel in his patent gives this measure of the prior art:

"The Fourdrinier wire has usually been arranged to move in a horizontal plane, although I am aware that means have been provided for adjusting the breast-roll end of the wire to different elevations, usually below the level, to provide for running with different grades of

stock—as, for instance, with quick stock and slow stock; but so far as I am aware the making-wire has always had to perform the work of drawing along the stock, and as the wire moved much faster than the stock the stock waved or rippled badly near the breast roll end of the wire, which gradually diminished until an equilibrium was established and a smooth, even, and glassy surface presented, and not until the waving or rippling ceased did the fibers lay down uniformly and produce a well-formed sheet of paper. The machine has been run necessarily at a slow rate of speed to give ample time for the water to escape and for the fibers to lay down so as to make a uniform sheet, and in case the time was insufficient the breast-roll end of the wire has been lowered still farther until the desired result was accomplished. In accordance with my invention I operate entirely above the level to cause the stock to travel by gravity at a velocity approximately equal to the speed of the making-wire, which I believe to be a new principle of operation."

It is important that the stock when it reaches the "Dandy" roll beyond the first suction box of the machine, shall be, on the one hand, free enough of water to be a formed sheet and take an impression from the Dandy roll, and on the other that it shall not be so dry that it will not retain the impression. Paper of such a heavy composition of fibre and water that it holds water long is said to be slow stock. Paper of lighter and thinner composition parting with water easily and drying quickly is called quick stock. Various means were adopted to give the stock the proper degree of dryness at the Dandy roll, usually by adjustment of the composition of the stock. What Eibel describes in this reference was another means. It was not widely used however. It was a slight depression or elevation in the wire at the breast roll so that slow stock could be made to run up hill from the flow box to the Dandy roll, lengthening the time of

the movement and thus giving more opportunity in its progress for the needed draining of the stock. On the other hand, fast or thin stock from which the water flowed too easily could be made to retain sufficient water by hastening its progress to the Dandy roll by the down-hill tilt of the wire. This tilt was obtained by raising the breast roll end of the wire either by putting shimming blocks under that end of the machine or by special devices to be described. The sole object was greater or less drainage of stock for the Dandy roll. The Eibel invention is distinguished from the prior art in two ways, first, in that the pitch of the wire was for a different purpose to be accomplished, not at the Dandy roll some twenty or more feet from the breast roll, but at a point only nine or ten feet from there, and, second, by the fact that to achieve his purpose a high or substantial pitch must be given to the wire, while only a small or trivial pitch was needed for the drainage of the prior art.[1]

This difference in purpose and degree of pitch between Eibel's device and the prior art is quite clearly shown by reference to a patent granted to Barrett and Horne, assignors to J. H. Horne & Sons, one of the important manufacturers of paper machinery of the country, in 1899. Their specifications showed a device capable of elevating the breast roll less than three inches and its sole purpose was for drainage. Their specifications say:

[1] It is true that defendant's expert Carter points out that in some of the machines of the prior art in which means were provided for tilting up the wire, the tilting was confined to that part of the surface length covered by the shake frame, say 18 feet, and did not extend to the first suction box, whereas Eibel's tilting involved the entire surface length of thirty feet. It would follow from this that the elevation of three inches in such machines would mean a greater angle of declination than three inches for the full surface length and that the disparity between three inches and twelve inches was not so great as the figures would lead one to think. But whatever difference this might make, the fact remains that Eibel's pitch was substantially greater than anything in the prior art.

"In certain kinds of pulp, notably the wood pulp which is now largely used in making paper, the water drains away very rapidly, so that the pulp may become nearly dry before it leaves the shake-frame, and thus not be properly laid when it reaches the rollers. This tendency may be obviated to a considerable extent by downwardly inclining the shake frame toward the rollers, so that the water tends to travel along with the pulp and will not, therefore, drain out through the wire so rapidly. It is further desirable that the amount of inclination or slope should be variable, so as to adapt the machine for pulp of different kinds or grades."

The Bayliss Austin machine, one of three chiefly relied on to show prior use, was made by the Horne Company and was designed by Barrett and Horne on the model of this patent. It is very clear from an examination of the design and contract for this machine that the pitch of the wire in it could not have exceeded three inches and that it was used for drainage. Other patents were set up in defense, some of them showing devices for raising the breast roll and wire above the level, and lowering them below the level for the purpose of drainage. The angle of elevation and depression was always small. There was a constant straining by the witnesses for the defense to increase the elevation before Eibel. On the direct examination they began with a positive assertion that a pitch of four, five, and even six inches, had been used in certain machines before Eibel's time, but written records, contracts and specifications brought out on cross-examination show nothing more than three inches provided for purpose of drainage and not more than that was used. This is not to say that witnesses in the face of such records did not testify to a higher elevation, but in such cases the amount of elevation rested in memory running back more than ten or fifteen years, a memory stimulated by the subsequent high pitches of Eibel and the retrospect of the

progress that now seems so easy and clear to every one. There was, too, always indefiniteness as to when such increase in elevation of the wire had taken place, whether before or after August, 1906, Eibel's date, and there was no evidence of weight, we think, after a full examination of the record, sufficient to justify a finding that such elevations had ever exceeded three inches before his application.

This is confirmed by the fact that greater elevation was not needed for the purpose of drainage for which it was devised and used. It is true that some witnesses testify that they realized before Eibel's application that speeding up the stock to equal velocity with the wire would solve the difficulty and aid the speed. But there is not a single written record, letter or specification of prior date to Eibel's application that discloses any such discovery by anyone, or the use of the pitch of the wire to aid the speed of the machine. The oral evidence on this point falls far short of being enough to overcome the presumption of novelty from the granting of the patent. The temptation to remember in such cases and the ease with which honest witnesses can convince themselves after many years of having had a conception at the basis of a valuable patent, are well known in this branch of law, and have properly led to a rule that evidence to prove prior discovery must be clear and satisfactory. *Barbed Wire Patent Case,* 143 U. S. 275, 284; *Loom Co.* v. *Higgins,* 105 U. S. 580, 591. Indeed when we consider the indisputable fact that Eibel's successful experiment at Rhinelander and his application for a patent surprised the whole paper trade, and that for a short time many held back from risking so radical a change and then all adopted it, oral evidence that some persons had discovered the source of trouble and the means of remedying it some years before Eibel is incredible. We are confirmed in this conclusion by the finding of Judge Hale in the District Court which is not

offset by the reversal of his decree in the Circuit Court of Appeals because that court seems to have reached its conclusion chiefly on other grounds yet to be considered.

The defendant's counsel contend that the specifications of the Eibel patent require that the only force to be used in giving speed to the stock shall be the force of gravity created by the angle of down hill inclination of the wire. They say that the patentee mentions no other means of acceleration, that he must be confined to this, and that a machine which uses other factors for this purpose does not infringe. We do not understand the Circuit Court of Appeals to go quite so far, but it does seem to give a construction requiring the force of gravity caused by the pitch of the wire to be the predominating cause of the increased speed of the stock. The factors of speed of the stock in such a machine before the factor of pitch was applied to increase it, were the head or hydraulic pressure of the stock in the flow box behind the slice, imparting movement to it as it came out on to the wire under the lifted slice, and the carrying effect of the moving wire upon the fluid stock as it fell upon the wire and proceeded gradually to form into a web as the fibres were laid and the water drained.

Many calculations were made by defendant's expert Carter, based on the laws of hydraulic pressure and flow, to show that under varying conditions of head and pitch and the speed of the wire, the chief factor would be head, the next the "drag" or carrying effect of the wire and the least in degree and importance in making the velocity of the stock and the wire equal would be the pitch, and that Eibel's invention could not be present because the "drag" of the wire and its influence upon the speed of the stock must be eliminated under Eibel's specifications. We do not so understand it. As the stock descends upon the wire with the head of the flow box, it is thin and liquid, the wire at its greater speed necessarily imparts addi-

tional speed to the stock and in its unformed fluidity the added speed does not disturb or ripple the stock to the injury of the process of paper making. It is only after the stock proceeds a third or a half of the surface length of the wire that the point is reached where the overspeed of the drag becomes troublesome in the felting or formation of the web of the pulp. Before that point is reached, the "drag" may be useful in bringing the speed of the stock nearer to that of the wire without injury. The truth seems to be, and this is brought out with force in the testimony of the defendant's expert witness Livermore, that while it is possible to calculate to a nicety the velocity of the free flowing liquid stock due to head and pitch, when unaffected by drainage, variation in viscosity and fluidity and the like, yet when these conditions are present, as they always are, and the other less calculable factor of the drag of the wire enters the problem, there is no means, short of actual experiment, to enable one to anticipate results and it is quite impossible to apportion to each factor its real influence. This fact reflects on the question whether Eibel's discovery was invention rather than the mere obvious and simple application of known natural forces.

The defendant introduced expert evidence to show that with a head of 2¼ inches in the flow box and a speed of 585 feet to the minute in the wire, and excluding the factor of "drag" of the wire, it would require an elevation of 48 inches to make up the difference in speed of the stock given by the head and the speed of the wire at a distance 10 feet from the point of discharge on the wire. The conclusion drawn from this seems to be that as no practical machine uses 48 inches pitch, the Eibel invention has never been used or infringed. Disregarding its error in omitting necessary factors already adverted to, this reasoning seems to us to depend on too narrow a construction of the patent.

In administering the patent law the court first looks into the art to find what the real merit of the alleged discovery or invention is and whether it has advanced the art substantially. If it has done so, then the court is liberal in its construction of the patent to secure to the inventor the reward he deserves. If what he has done works only a slight step forward and that which he says is a discovery is on the border line between mere mechanical change and real invention, then his patent, if sustained, will be given a narrow scope and infringement will be found only in approximate copies of the new device. It is this differing attitude of the courts toward genuine discoveries and slight improvements that reconciles the sometimes apparently conflicting instances of construing specifications and the finding of equivalents in alleged infringements. In the case before us, for the reasons we have already reviewed, we think that Eibel made a very useful discovery which has substantially advanced the art. His was not a pioneer patent, creating a new art; but a patent which is only an improvement on an old machine may be very meritorious and entitled to liberal treatment. Indeed, when one notes the crude working of machines of famous pioneer inventions and discoveries, and compares them with the modern machines and processes exemplifying the principle of the pioneer discovery, one hesitates in the division of credit between the original inventor and the improvers; and certainly finds no reason to withhold from the really meritorious improver, the application of the rule "*ut res magis valeat quam pereat,*" which has been sustained in so many cases in this Court. *Winans* v. *Denmead,* 15 How. 338, 341; *Corning* v. *Burden,* 15 How. 265, 269; *Turrill* v. *Railroad Co.,* 1 Wall. 491, 510; *Rubber Co.* v. *Goodyear,* 9 Wall. 788, 795; *McClain* v. *Ortmayer,* 141 U. S. 419, 425.

Eibel was an avowed improver, not in the art of paper making generally, but upon a well-known and universally

used machine. In that machine, the speed of the stock which was the subject matter of his improvement, had always been controlled by two factors, the head of the stock in the flow box, and the carrying effect of the under moving wire. He says nothing in his specifications to exclude these factors, he merely adds another factor of speed to secure the equality of speed of the stock with the wire. He says:

"For the purpose of increasing the speed of the machine to the maximum I maintain the breast-roll end of the making-wire at a high elevation above the level, so that the stock travels by gravity much faster than the making-wire ordinarily runs for a certain grade of stock, and I then increase the speed of the machine to such extent as to bring the rate of speed of the making-wire up to the speed of the rapidly-moving stock, and as a result the capacity of the machine is largely increased."

We agree fully with Judge Hale in the District Court in his comment on this:

"The process invented by him (Eibel) begins to operate after the stock has entered upon the wire. His apparent attempt was to get rid of bubbles and wrinkles, before he got to the place on the machine where the paper is formed. To do this, he allowed gravity to work with 'drag' and with 'head.' He harnessed all the elements he could find. He brought gravity in with the other elements, and so brought the speed of the stock up to equality with that of the wire. By this means he achieved high speed and also freed the stock on the wire from waves and ripples." 267 Fed. 855.

The Circuit Court of Appeals questions the assumption that gravity was a new factor with Eibel, because the head of the flow box is only another application of the force of gravity. This is a mere criticism of a term which whether accurate or not is not misleading. What Eibel was dealing with in his patent as a new factor was the additional

force acquired by the pitch of the wire and that he called gravity, and Judge Hale in the passage quoted uses the word with the same meaning and without any confusion to the reader.

We think, then, that the Eibel patent is to be construed to cover a Fourdrinier machine in which the pitch of the wire is used as an appreciable factor, in addition to the factors of speed theretofore known in the machine, in bringing about an approximation to the equal velocity of the stock and the wire at the point where but for such approximation the injurious disturbance and ripples of the stock would be produced.

The next objection to the patent which prevailed in the Circuit Court of Appeals is that its terms are too vague because the extent of the factor of pitch is not defined except by the terms "substantial" and "high". The figure accompanying the specification and illustrating the improvement indicates an angle of four per cent. or an elevation of 12 inches, and the reference to the small elevations for drainage shown in earlier devices indicates that the patentee had in mind elevations substantial as compared with them in order to achieve his purpose of substantially increasing the speed of the stock. It was difficult for him to be more definite, due to the varying conditions of speed and stock existing in the operations of Fourdrinier machines and the necessary variation in the pitch to be used to accomplish the purpose of his invention. Indefiniteness is objectionable because the patent does not disclose to the public how the discovery, if there is one, can be made useful and how its infringement may be avoided. We do not think any such consequences are involved here. This patent and its specifications were manifested to readers who were skilled in the art of paper making and versed in the use of the Fourdrinier machine. The evidence discloses that one, so skilled, had no diffi-

culty, when his attention was called to their importance, in fixing the place of the disturbance and ripples to be removed, or in determining what was the substantial pitch needed to equalize the speeds of the stock and wire at that place. The immediate and successful use of the pitch for this purpose by the owners of the then fastest machines and by the whole trade is convincing proof that one versed in paper making could find in Eibel's specifications all he needed to know, to avail himself of the invention. Expressions quite as indefinite as "high" and "substantial" in describing an invention or discovery in patent specifications and claims have been recognized by this Court as sufficient. In *Tilghman* v. *Proctor,* 102 U. S. 707, the claim sustained was for "the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure." See also *Rubber Co.* v. *Goodyear,* 9 Wall. 788, 794; *Mowry* v. *Whitney,* 14 Wall. 620, 629; *Lawther* v. *Hamilton,* 124 U. S. 1, 9; *Carnegie Steel Co.* v. *Cambria Iron Co.,* 185 U. S. 403, 436; *Abercrombie & Fitch Co.* v. *Baldwin,* 245 U. S. 198, 205.

It is contended on behalf of the defendant that whether Barrett and Horne perceived the advantage of speeding up the stock to an equality with the wire, yet the necessary effect of their devices was to achieve that result and therefore their machine anticipated Eibel. In the first place we find no evidence that any pitch of the wire, used before Eibel, had brought about such a result as that sought by him, and in the second place if it had done so under unusual conditions, accidental results, not intended and not appreciated, do not constitute anticipation. *Tilghman* v. *Proctor,* 102 U. S. 707, 711; *Pittsburgh Reduction Co.* v. *Cowles Electric Co.,* 55 Fed. 301, 307; *Andrews* v. *Carman,* 13 Blatchf. 307, 323.

It is next objected that the alleged invention covers only a matter of degree in pitch which can not be the subject of a patent. The prior art showed the application

of gravity by use of the pitch of the wire to the improvement of the Fourdrinier machine and Eibel, it is said, merely increased degree of pitch and gravity for the same general purpose. We think this attack upon the patent can not prevail. Eibel's high or substantial pitch was directed toward a wholly different object from that of the prior art. He was seeking thereby to remove the disturbance and ripples in the formation of the stock about ten feet from the discharge, while the slight pitches of the prior art were planned to overcome the dryness in the formed web of the stock at double the distance from the discharge. It would seem that the greater speed of the stock produced by Eibel would make difficult the joint application of the principles of Eibel and Barrett and Horne, and that the function of adjusting the drainage for the Dandy roll must be carried on by some of the other methods known to the art when Eibel's pitch is used. But however this may be, the object of the one was entirely different from that of the other. Livermore, an expert witness called by the defendant, when asked the question whether the purpose of the Barrett and Horne patent had anything in common with the theory of the Eibel patent, answered:

"I should say not. It looks to me as if Barrett and Horne referred to the adjustment of inclination with one effect in mind, and that Eibel referred to like adjustment with another effect in mind. . . . In this particular case, the two effects have, so far as I can see, no special correlation to one another, and an adjustment made with one effect in mind might or might not produce a desirable effect as to the other function or phenomenon."

In considering this phase of the controversy, we must not lose sight of the fact that one essential part of Eibel's discovery was that the trouble causing the defective paper product under high machine speed was in the disturbance and ripples some ten feet from the discharge and that

they were due to the unequal speeds of stock and wire at that point and could be removed by equalizing the speeds. The invention was not the mere use of a high or substantial pitch to remedy a known source of trouble. It was the discovery of the source not before known and the application of the remedy for which Eibel was entitled to be rewarded in his patent. Had the trouble which Eibel sought to remedy been the well known difficulty of too great wetness or dryness of the web at the Dandy roll and had he found that a higher rather than a low pitch would do that work better, a patent for this improvement might well have been attacked on the ground that he was seeking monopoly for a mere matter of degree. But that is not this case. On the other hand, if all knew that the source of the trouble Eibel was seeking to remedy was where he found it to be and also knew that increased speed of the stock would remedy it, doubtless it would not have been invention on his part to use the pitch of the wire to increase the speed of the stock when such pitch had been used before to do the same thing although for a different purpose and in a less degree. We can not agree with the Circuit Court of Appeals that the causal connection between the unequal speeds of the stock and the wire, and the disturbance and rippling of the stock, and between the latter and the defective quality of the paper in high speeds of the machine was so obvious that perception of it did not involve discovery which will support a patent. The fact that in a decade of an eager quest for higher speeds this important chain of circumstances had escaped observation, the fact that no one had applied a remedy for the consequent trouble until Eibel, and the final fact that when he made known his discovery, all adopted his remedy, leave no doubt in our minds that what he saw and did was not obvious and did involve discovery and invention.

The Circuit Court of Appeals dwells on the fact that the use of the pitch of the wire was not really the intro-

duction of a new factor in the solution of the problem because the same result would have followed if the head of the flow box had been made greater in order to increase by gravity the speed of the stock. Doubtless this could have been done. There were difficulties, however, in such a method when Eibel's application was filed, because in the then machines the flow box was supported by an apron over the wire and the necessary addition to the weight of the stock in the flow box, in increasing the head, would have interfered with the free working of the wire. Since that time an improvement has been adopted by which the flow box does not rest on the wire and additional head can be imparted to the stock. The defendant invites attention to the fact that one or two paper makers are increasing this head and giving up the pitch, for the purpose of increasing the speed of the stock. We do not see that these circumstances in any way affect the validity of the Eibel patent. If defendant or others can do what Eibel accomplished in another way, and by means he did not include in his specifications and claims, i. e., by additional head and the abandonment of a substantial pitch, they are at liberty to do so and avoid infringement.

We come finally to the question of infringement. If the Eibel patent is to be construed as we have construed it, there can be no doubt that the defendant uses the Eibel invention. The device which the defendant uses for tilting the wire, i. e., by shimming blocks, and that for regulating and increasing the speed of the wire, are plainly equivalents of the same elements in the new combination which Eibel shows in his drawings and specifications. The defendant uses a Fourdrinier machine having the breast roll end of the paper-making wire maintained at an elevation of 15 inches above the level whereby the stock is caused to travel by gravity rapidly in the direction of the movement of the wire and at a speed approximately

equal to the speed of the wire substantially as described. This brings the defendant's machines within the first claim of the patent if 15 inches is a substantial elevation of the making wire, as all the witnesses concede that it is. The same conclusion must be reached as to the second claim because the defendant uses a machine "having the breast-roll end of the paper-making wire maintained at a high elevation, whereby the stock is caused to travel by gravity faster than the normal speed of the wire for a certain grade of stock, and having means for increasing the speed of the machine to cause the wire to travel at substantially the same rate of speed as the rapidly-moving stock, substantially as described." The same thing is true of the third claim.

Question has been made whether these three claims are for a machine or a process. We think they are claims for a machine, i. e., for an improvement on a machine, and that the devices for such improvement, to wit, the elevation by a screw or other equivalent method, and the control of the speed of the wire, are shown by the specifications and the figures, together with a sufficient description of their operation.

The seventh and eighth claims are for the same improvement with the suction boxes changed from their usual position in the unimproved machine to make them effectively function on the pitched wire. They are machine claims and are infringed by the defendant. Their new adjustment is part of a new combination and the words substantially as described limit them to a combination including the elements included in the first three claims.

Claim No. 12 is as follows:

"12. In a Fourdrinier machine, a downwardly-moving paper-making wire, the declination and speed of which are so regulated that the velocity of the stock down the declining wire, caused by gravity, is so related to the

velocity of the wire in the same direction, that waves and ripples on the stock are substantially avoided and the fibers deposited with substantial uniformity on the wire, substantially as described."

This comes nearer to being a process claim but whether it is or not the defendant infringes it.

The evidence discloses that after the suit was brought, the defendant reduced the pitch of one of its machines to six inches and the contention of defendant is that the machine ran as well and gave as good results as when its pitch was 15 inches. We are not called upon to decide whether this contention can be sustained because the reduction was after the bill was filed. It may be noted, however, that the admissions of witnesses seem to show that this reduction was made for purposes of the suit and that immediately after the defendant won the suit in the Circuit Court of Appeals, it restored the pitch of this machine to 15 inches, and when the decree of the Circuit Court of Appeals proved not to be final, the wire was lowered again to a 6-inch pitch. Much evidence was taken and much discussion has followed upon the point whether a 6-inch pitch accomplishing in whole or in part what Eibel sought to do would infringe a patent for a substantial pitch. We do not find it necessary to pass definitely on the question because it is not before us on the record, though we can not prevent the natural inferences upon this point to be drawn from the conclusions we have reached.

The decree of the Circuit Court of Appeals dismissing the bill is reversed and the decree of the District Court is affirmed.